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SHORT REPORT

A New Surgical Approach for Exclusion of Renal Artery Aneurysms Avoiding Organ Ischemia

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Abstract *Introduction:* Surgical treatment of renal artery aneurysms is inevitably associated with temporary renal artery occlusion and risk of ischemic injury. We present a technique for renal artery grafting and aneurysm exclusion without interrupting renal blood flow.
Report: A symptomatic renal artery aneurysm was bypassed with a venous graft between the abdominal aorta and the very distal renal artery utilizing a distal anastomotic device without interruption of renal blood flow. The aneurysm was then excluded by means of hemostatic clips.
Conclusion: The presented surgical technique offers the major advantage of avoiding organ ischemia and accelerating the surgical procedure.

Introduction

The technique for surgical treatment of renal artery aneurysms depends on their size and exact localization.[1] In all available options, however, the renal artery has to be temporarily occluded, a manoeuvre inevitably associated with the risk of ischemic injury.

We present a technique for renal artery grafting and aneurysm exclusion without interruption of renal blood flow.

Report

We used this technique in a 40-year-old female patient with an embolizing distal renal artery aneurysm (diameter 21 mm — Fig. 2A) neither suitable for coil embolization ("wide neck") nor for exclusion with a covered stent.

The renal artery was approached retroperitoneally. A saphenous vein graft was loaded on the C-Port xA™ device (Cardica, Inc., Redwood City, California, USA) designed to

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create a stapled anastomosis. The distal anastomotic site was dissected free over a length of 20 mm. The anvil of the device was introduced into the target vessel through a 1.0 mm stab incision and the device was deployed (Fig. 1A). The target vessels were joined with 13 individual stainless steel microclips. An arteriotomy of approximately 4.5 mm in length was created automatically. Following deployment the device was retracted and the anvil insertion hole was closed with a single 7-0 polypropylene suture (Fig. 1B). Anastomotic time was 2 minutes. A second segment of the saphenous vein was connected to the aorta without side clamping (anastomotic time 30 seconds) using the PAS-Port™ System (Cardica, Inc., Redwood City, California, USA), followed by a hand-sewn anastomosis between the two vein segments (anastomotic time 6 minutes).

Transit time flow measurements (TTF) (Medi-Stim ASA, Oslo, Norway) revealed 71 ml/min of blood flow through the graft, the pulsatility index (PI) was 1.7. The aneurysm was excluded proximally and distally with hemostatic clips. Thereafter bypass flow increased to 154 ml/min (PI 1.3). Serum creatinine levels remained stable (preoperative: 90, 1st and 3rd postoperative day 86 and 88 μmol/l respectively). The CT scan at discharge documented a satisfactory result (Fig. 2B) and the absence of renal infarctions.

During the early follow-up period arterial pressure returned to normal and antihypertensive treatment could be completely withdrawn. Arterial hypertension reappeared 6 months later and the patient complained of headaches. A CT scan confirmed the patency of the proximal and distal anastomoses, however a significant

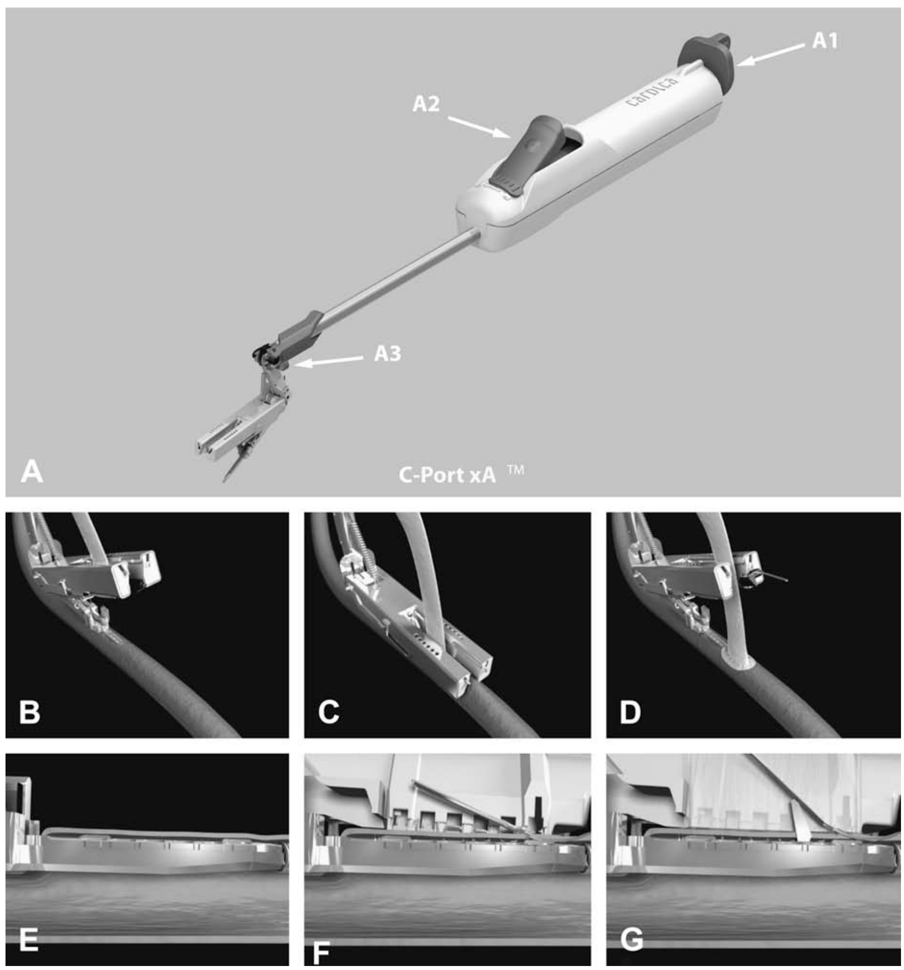

Fig. 1 A: The C-Port xA™ device: A1 denotes the actuator knob. By turning the actuator knob the CO_2 cartridge is pierced (all device actions are CO_2 driven). A2 indicates the trigger. The end-effector (A3) can be rotated through a 180 degree arc to suite individual deployment angles. B—D: these computer-generated images demonstrate the deployment sequence as seen by the surgeon. B: anvil inserted into the lumen of the target vessel through a 1 mm arteriotomy. C: trigger pressed half-way, the end-effector with the graft loaded is lowered and engaged, further compression of the trigger completed the anastomosis. D: trigger released, the end-effector raises automatically, the device is retracted carefully (the anvil insertion hole is then secured with one stitch). E—G: these computer-generated images demonstrate three sequential steps of the anastomosis creation (right: toe, left: heel of the anastomosis): E: anvil in lumen and held adjacent to the anterior wall of the target vessel. F: the micro-clips are deployed and formed against the intraluminal anvil (from the toe to the heel). G: the micro-arteriotomy knife hidden in the anvil comes into a vertical position and performs the arteriotomy before being retracted into the anvil at the end of deployment. The oblique structure (protection shield) seen in the lumen of the graft (in F and G) protects the hood of the anastomosis from the arteriotomy knife.

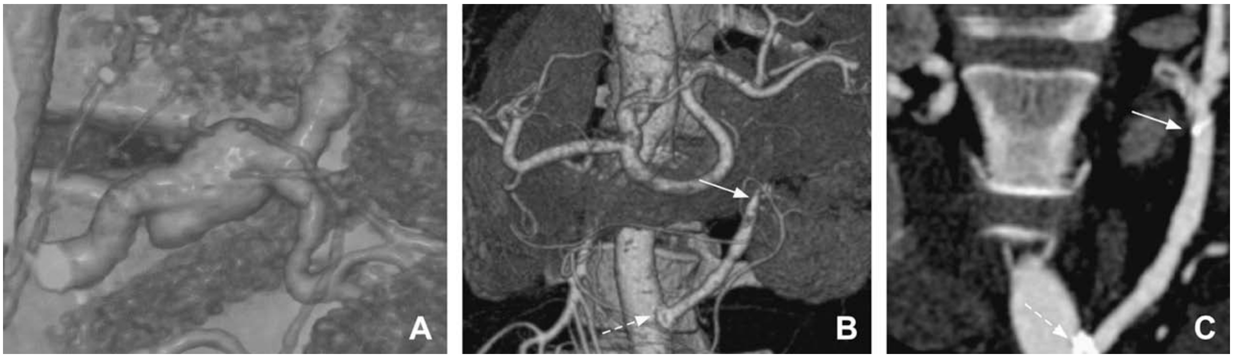

Fig. 2 A: Three-dimensional reconstruction (volume rendering technique) of the distal left renal artery aneurysm (angio-CT scan). B: Three-dimensional reconstruction (volume rendering technique) of the vein bypass at discharge (angio-CT scan). C: Control-MRI (maximal intensity projection technique) after PTA. The dotted arrows point to the proximal anastomosis (PAS-Port™ implant), the full arrows point to the distal anastomosis (13 individual microclips).

stenosis was found at the hand-sewn anastomosis between the two vein segments. The stenosis was treated by percutaneous transcatheter angioplasty (PTA). The final result was satisfactory with good distal flow. The patient recovered fully and became normotensive. Three months later a MRI confirmed freedom from restenosis (Fig. 2C). At clinical follow-up 12 months after the procedure blood pressure was normal and the patient remained asymptomatic.

Discussion

Anastomosis creation with the C-Port system has been previously described.[2] This device enables the creation of a compliant termino-lateral anastomosis without interrupting the target vessel's blood flow. Graft loading is fast and simple. Objective intraoperative patency control is crucial,[3] since there is no visual control during the automated anastomosis creation.

Visualization through the retroperitoneal approach was satisfactory. The proximal anastomosis on the abdominal aorta can then be performed in a routine fashion. Alternatively the PAS-Port™ System[4] can be used when the conventional approach is contraindicated due to atherosclerotic disease or not practical due to limited working space. When graft length is shorter than 8 cm (as in our patient), using of two separate vein segments (with the additional risk of the third anastomosis) is preferable.

The use of automated anastomotic devices enabled the safe exclusion of a left renal artery aneurysm without interrupting renal arterial blood flow, thereby avoiding organ ischemia and accelerating the surgical procedure. The availability of such devices enriches the surgical armamentarium for these and other similar vascular surgical interventions.[5] However, long term results should be awaited before adopting these techniques for more general use.

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